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James N. Dertouzos

September 1984

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The Rand Corporation, 1700 Main Street, P.O. Box 2138, Santa Monica, CA 90406-2138

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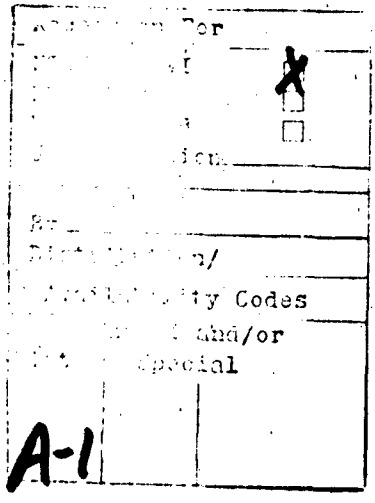

ENLISTMENT SUPPLY, RECRUITER OBJECTIVES, AND THE ALL-VOLUNTEER ARMY

By James N. Dertouzos*

Several factors could threaten the viability of the all-volunteer army in the years ahead. A declining youth population, enhanced civilian employment opportunities, and increased emphasis on budgetary restraint may make it difficult to attract the desired quantity of enlistments. In addition, the increasing sophistication of military hardware may require concomitantly greater skill and intelligence on the part of enlisted personnel.

In such a setting, policy makers need information in order to respond to demographic and economic changes with an appropriate allocation of limited recruiting resources. Unfortunately, past research has failed to come to any general consensus regarding the relative importance of factors affecting enlistment supply.[1] This failure stems, in large part, from a fundamantal flaw in the methodology employed in most manpower studies.[2] In particular, the observed

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*The Rand Corporation, Santa Monica, California 90406. This research was sponsored by the Office of the Assistant Secretary of Defense (Manpower, Installations, and Logistics). I thank Richard Fernandez, Glen Gotz, James Hosek, John McCall, Mike Polich, James Press, and Peter Stan for valuable comments.

[1]Some of the more recent examples include Cralley (1979), Fernandez (1979), Huck and Allen (1977), Morey (1980), Hanssens and Levien (1983), and Ash, Udis, and McNown (1983).

[2]More generally, it can be argued that many empirical studies are similarly hampered by the failure to recognize that economic data are most often generated by choices of private agents who are constrained by market-determined variables. See Sargent (1981).

production of enlistments is assumed, at least implicitly, to be determined solely by supply factors. However, recruiters do not passively process enlistments. Rather, by allocating time differently in response to quotas and the incentives provided for achieving and exceeding these quotas, they alter both the quantity and quality of enlistments.

This work begins to remedy the past deficiencies by explicitly considering the interaction of these demand factors and variables characterizing supply in the determination of enlistment outcomes. The paper is organized as follows. Section I introduces the concept of production "tradeoffs" between categories of enlistments and utilizes a simple model of recruiter behavior in illustrating the importance of quotas and incentives in the choice of an enlistment mix. The next section provides an empirical application of a more general model, utilizing monthly Army enlistment data for 1980 and 1981. The results suggest that the traditional focus only on the supply of recruits yields estimates which can significantly understate the importance of economic and resource allocation factors. Finally, Section III discusses some of the major policy and research implications of the results.

I. RECRUITER TRADEOFFS AND ENLISTMENT SUPPLY

Previous studies assume that the supply of high quality enlistments[3] is determined by economic factors such as civilian wages and alternative employment opportunities as well as recruiting resource expenditures including military pay, advertising, and the number of recruiters. A general functional form representing this relationship would therefore be:

$$H = f(X,R)$$

where H, X, and R represent the number of high quality enlistments, economic variables, and recruiting resources respectively. The implicit assumption is that unlimited "low quality" enlistments can be secured costlessly. However, processing any volunteer requires significant paper work, counseling, and physical and mental testing before actual acceptance. Thus, an increase in the number of low quality recruits, L, will take time and resources away from activities which would increase high quality enlistments. The appropriate model becomes:

$$f(H,L,X,R) = 0 \quad (1)$$

In order to estimate equation (1) it is necessary to model enlistment demand or recruiter objectives. Recruiters are evaluated on the basis of the quantity and quality of enlistees they attract. Given the range of feasible production, recruiter choices will depend on the rewards associated with different combinations of enlistments. Army

[3]A high quality enlistment is conventionally defined as a high school graduate (or senior who will graduate) who performs at or above the 50th percentile on the Armed Forces Qualification Test (AFQT). This definition seems somewhat arbitrary since there exists little convincing evidence that subsequent performance of these individuals is measurably superior to others.

recruiters are given monthly quotas or goals by category of recruits. Success or failure as a recruiter (or recruiting area commander) is measured on the basis of performance relative to these quotas. Thus, the general formulation for recruiter objectives can be given as:

$$U = g(H,L,Q) \tag{2}$$

where Q is a vector of quotas or enlistment goals, by category. The recruiter or recruiting area will maximize the objective (2) subject to the supply constraint (1). This process yields first order conditions for a maximum:[4]

$$g_H/g_L = f_H/f_L \tag{3}$$

The first-order condition, along with the supply relationship (1) may be combined to derive reduced-form expressions which reflect the interaction of both supply and demand for enlistments:

$$H = \phi_1(X,R,Q) \tag{4}$$

and

$$L = \phi_2(X,R,Q) \tag{5}$$

These equations express numbers of high and low quality enlistments as functions of all exogenous variables affecting both supply and demand. Unfortunately, without imposing further restrictions on the underlying relationships (1) and (2), the model yields few qualitative predictions.[5]

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[4] In other words, the marginal rate of substitution of high quality for low quality enlistments in the recruiter's objective function equals the potential tradeoff given by the slope of the supply relationship. The second-order condition concerns the relative rates at which the recruiters' indifference curve and the enlistment supply curves are changing.

[5] At this stage of generality, the signs of most of the partial derivatives of (4) and (5) are ambiguous. All that can be said is that $\partial H/\partial Q$ is opposite in sign to $\partial L/\partial Q$. That is, a change in quotas will alter objectives, but will not disturb supply relationships. So, if recruiters opt for more high quality, it must be at the expense of low quality enlistments. In view of the theory of conjugate pairs (Archibald, 1965) this is not surprising.

Figure 1 illustrates a simple model of recruiter behavior and the implications for estimating enlistment supply. The curved solid line aa' represents the recruiting possibilities frontier, showing all feasible combinations of high (H) and low (L) quality enlistments possible given a particular market environment and level of recruiting resource expenditures. Recruiters, by engaging in different types of activities, can choose any point on this frontier, thereby altering the mix of enlistments to include either greater or fewer numbers of high quality recruits.

Now, imagine that a recruiting area is given a quota or goal for total enlistments and, above all else, recruiters will strive to attract a total number of enlistments equal to this quota. In figure 1, the 45 degree lines represent combinations totaling Q_1 and Q_2 respectively. Now, once the overall goal is achieved, recruiters will attempt to secure the highest percentage of high quality enlistments possible. In other words, recruiters choose the feasible outcome which maximizes high quality enlistments subject to the condition that $H + L = Q$.[6] So, under supply conditions represented by the frontier aa' and with an overall quota of Q_1, point A will be chosen.

A changing environment or resource level results in a shift in the recruiting possibility curve. For example, an unemployment rise could increase the range of potential enlistments with the recruiting frontier curve expanding to the dashed line bb'. However, the resulting change in high and low quality enlistments depends on the size of the shift but

[6]This characterization of recruiter behavior is illustrative but overly simplistic. As suggested earlier, Army recruiters are given quotas for high and low quality categories separately. A more general model is estimated below.

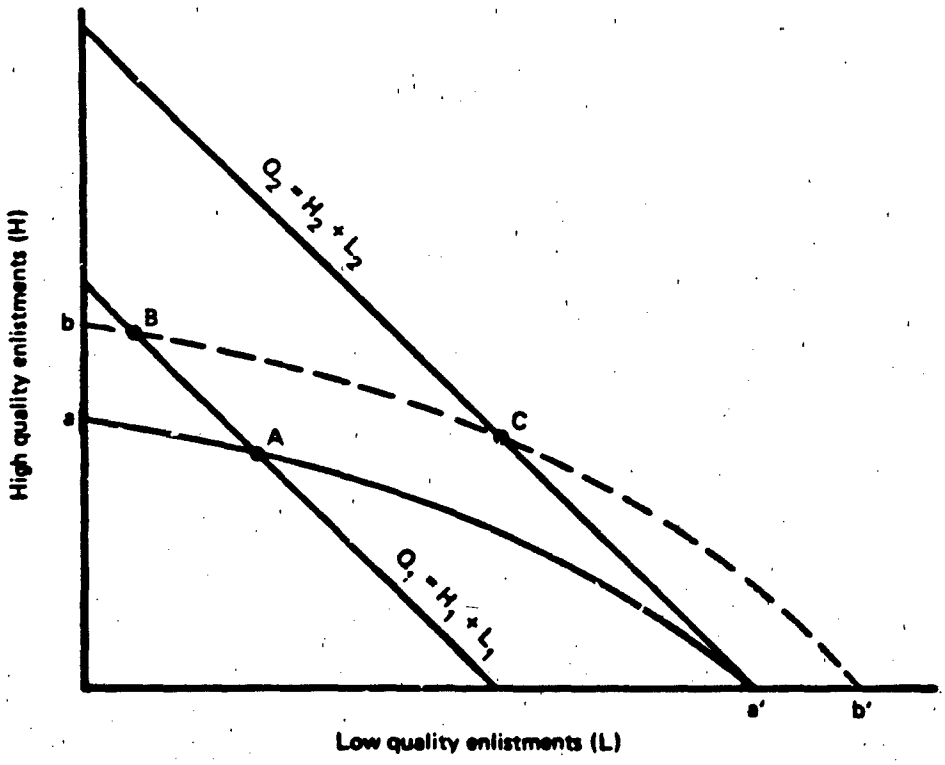
$Q_2 = H_2 + L_2$
$Q_1 = H_1 + L_1$
b
B
a
A
C
a'
b'
High quality enlistments (H)
Low quality enlistments (L)

FIGURE 1

also on the point chosen along the new curv . If quotas do not change, point B will be chosen, representing a large increase in the number of high quality recruits. On the other hand, if total quotas are simultaneously increased to Q_2, point C will be chosen. For this outcome, a negligible change in high quality enlistments is observed even though low quality enlistments have increased substantially. Clearly, an analysis of only the former, with no consideration of quotas and enlistment mix changes, could yield misleading results.

If supply conditions enable recruiters to achieve quotas for all categories easily, the solution may be further complicated if recruiters do not have sufficient incentives to fully utilize resources and overproduce. Indeed, if future quota levels are altered to conform to current production, recruiters may conclude that it is in their best interest not to exceed quotas significantly.[7] If they did, present success could guarantee future failure, especially if the recruiting environment deteriorates. In addition, if rewards for overproduction are viewed as being meager, recruiters may choose to enlist fewer high and low quality individuals.[8]

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[7]For example, it is commonly observed in the central planning literature that quota overfulfillment can increase future requirements. See Nove (1977).

[8]The services reward overproduction, i.e., exceeding quotas, to some degree. For example, the Army awards badges, rings, and letters of commendation at different levels of achievement. However, we will see that these rewards may not be taken very seriously by all recruiters. Unfortunately, observed enlistments in such circumstances can no longer be assumed to be on the production trade-off curve, thereby making statistical identification of enlistment supply relationships quite difficult. Future research efforts should attempt to include an explicit treatment of the labor-leisure substitution in this context.

II. EMPIRICAL RESULTS

In theory, recruiter quotas and incentives to achieve and exceed them can have dramatic effects on observed enlistment levels. To test this theory, a simultaneous equation model of enlistment supply and demand was applied to monthly data from the Army for 1980 and 1981.

A. DATA DESCRIPTION

The units of observation were areas served by individual Military Entrance Processing Stations (MEPS), of which there were 67 during this time period. In order to limit model complexity, data were utilized only from the 33 MEPS that were not affected by a variety of experimental educational assistance test programs which were in operation at the time. The data include observations on enlistment contracts, local employment conditions, area populations, civilian wage opportunities, production recruiters, and quotas.[9] Table 1 provides variable definitions and mean values for 1980 and 1981.

B. ESTIMATING EQUATIONS

The general expressions for enlistment supply and demand must be given specific functional forms for empirical implementation. As a first approximation, assume that the supply relationship has the following log-linear form:[10]

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[9]For a more detailed description of the data employed, see Fernandez (1982).

[10]The algebraic formulation employed for empirical purposes imposes a trade-off curve which is convex to the origin. Although the implied increasing returns to specialization could make sense at interior points, this is not likely for all ranges of production, especially as enlistments asymptotically approach population limits. Thus, the relationship should be viewed as a local approximation that facilitates comparison with more traditional models of enlistment supply. Future work should utilize functional forms which are more flexible.

Table 1

VARIABLE DEFINITIONS AND MEAN VALUES

Variable	Definition	Mean	
		1980	1981
H	Enlistees having High School diplomas, AFQT: 50+ percentile	39.6	46.9
L	Enlistees having High School diplomas, AFQT: 50- percentile	64.1	58.2
U	Unemployment rate, all workers 16 years of age or older	6.9	7.2
W	Wages for manufacturing production workers, all ages	7.1	7.8
P	Population (1980) of males, 15-19 years of age (thousands)	165.6	165.6
R	Recruiters	75.9	74.9
Q_h	Quota for high quality accessions	49.7	40.7
Q_L	Quota for low quality accessions	67.6	66.7

(6) $$\log(H) = \lambda\log(L) + \beta_0 + \beta_1\log(U) + \beta_2\log(W) + \beta_3\log(R) + \beta_4\log(P) + \Sigma\beta_i M_i$$

where H and L are enlistments, U is the unemployment rate, W is the civilian opportunity wage rate, R is the number of production recruiters, P is an estimate of the 1980 census population for males 15-19 years of age, and the M_i's are monthly dummy variables meant to capture seasonal variations.[11]

[11]Only nine months of data for each year were readily available.

The trade-off parameter, λ, represents the elasticity of high quality enlistments with respect to low quality enlistments. If, as expected, low quality enlistments are easier to attract, λ will have a value of between 0 and -1. The β's can be interpreted as partial elasticities of high quality recruits with respect to unemployment, wages, and recruiters, respectively. They are "partial" because they are computed under the assumption that the number of low quality recruits is held constant.

The supply relationship (6) contains two endogenous variables, H and L, and cannot be estimated using single equation methods. Therefore, it is necessary to introduce an expression which takes account of recruiter objectives. As a first approximation, one can utilize specifications representing the reduced-form expressions (4) and (5). Assume that the equations for high and low quality enlistments are:

$$(7) \qquad \log(H) = \alpha_0 + \alpha_1\log(U) + \alpha_2\log(W) + \alpha_3\log(R) + \alpha_4\log(P) + \alpha_5\log(Q_h) + \alpha_6\log(Q_L)$$

$$(8) \qquad \log(L) = \gamma_0 + \gamma_1\log(U) + \gamma_2\log(W) + \gamma_3\log(R) + \gamma_4\log(P) + \gamma_5\log(Q_h) + \gamma_6\log(Q_L)$$

The joint estimation of either (7) or (8) along with the structural equation (6) provides estimates of the underlying supply relationships of primary interest to this study.[12]

[12] This procedure is equivalent to a two-stage least squares estimation of expression (6) with the quotas acting as instrumental variables. We will see that the estimates obtained were invariably similar to those derived using a more complicated non-linear full-information maximum likelihood method.

As an alternative, one can directly utilize an expression representing recruiter objectives. To illustrate, assume that recruiters, or recruiting districts, attempt to maximize some objective

$$U = \theta \log[(H/Q_h) - \gamma_h] + (1 - \theta)\log[(T/Q_t) - \gamma_t] \tag{9}$$

where T is the total number of enlistments, $T = H + L$, Q_h and Q_L are quotas for high and low quality enlistments, and Q_t is the total volume quota, $Q_t = Q_h + Q_L$. The shift parameters, γ_h and γ_t, can be given the interpretation of being "subsistence" levels of performance relative to quotas. That is, their value denotes the minimum acceptable percentage of the quotas that recruiters strive for. The weight parameter, θ, represents the relative importance of high versus low quality enlistments in the objectives of recruiters. If θ is close to a value of one, higher quality is emphasized as opposed to lower categories. It is clear that these parameters serve to generalize the expression and allow for a variety of objectives as special cases.[13]

Maximizing (9) subject to the supply relationship (6) yields the following first-order condition:

$$[\theta(T - \gamma_t Q_t)]/[(1 - \theta)(H - \gamma_h Q_h)] + 1 = L/\lambda H \tag{10}$$

It is possible, using nonlinear maximum likelihood estimation techniques, to estimate equations (6) and (10) jointly. If the model specification is correct, the system is exactly identified and the procedure yields consistent estimates of the coefficients and asymptotically efficient standard errors. The advantage in utilizing

[13] A variety of alternative characterizations may seem to be equally plausible. The "Stone-Geary" formulation above has several desirable properties. Most importantly, the parameters can be readily estimated and interpreted. Future research will investigate alternative approaches.

expression (10) is that the underlying parameters of recruiter objectives are identified as well as the structural supply relationships.[14]

C. EMPIRICAL ESTIMATES OF ENLISTMENT SUPPLY

Table 2 presents three sets of estimates for 1980. The first two sets report ordinary least squares coefficient estimates and standard errors for expression (7), the reduced form approximation for the number of high quality enlistments. The first set, however, excludes the quota variables which influence demand for enlistments. This specification represents the most common research approach. The second set includes the quota variables and can be interpreted as the reduced-form relationship between the number of high quality enlistments and factors which characterize both supply and demand. The last set reports results from the joint maximum likelihood estimation of the supply relationship (6) along with the reduced-form expression (8).

The comparison of reduced-form estimates for 1980 suggests that the inclusion of variables denoting enlistment demand can be quite important. In particular, the estimates indicate that the elasticity of high quality enlistments with respect to high quality quotas was .420 with a standard error of .094. An increase in quotas for low quality enlistments has an opposite but equivalent effect. In addition, the inclusion of quota variables changes the magnitude of other coefficients to some degree, though the qualitative nature of the results remains similar.[15]

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[14]Unfortunately, the procedure is quite costly. Some preliminary estimates using this approach are presented below.

[15]In general, we would expect that excluding quotas would bias the coefficients of variables which are correlated to the quotas. For example, large recruiting areas have higher quotas, bigger staffs, and are typically located in communities with greater wage rates. It is not

The reduced-form estimates for the elasticities with respect to economic factors are plausible for 1980. The estimated elasticity with respect to civilian earnings was negative and significant at -.808. In addition, the results indicate that unemployment rates are positively related to the number of high quality enlistments, holding other supply and demand factors constant. A 10-percent rise in the unemployment rate results in a 5.75 percent increase in the number of high quality recruits. On the other hand, the effect of male teenage population appears to be insignificant.[16]

The recruiter elasticity for the fully specified set of reduced-form estimates was positive and significant. For the 1980 data, the elasticity of high quality recruits with respect to recruiters was estimated to be .842, with a standard error of .153. This is somewhat lower than the estimate derived from the expression which ignores demand factors.

The third set of estimates presents coefficients from the supply relationship or trade-off curve (6). The estimated elasticities are uniformly larger in absolute value for all supply variables. This is as expected, since they represent partial elasticities or the expected

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surprising, therefore, that these coefficients were most affected. The correlations with unemployment rates and the monthly dummy variables are less obvious and, thus, the estimates change very little for these explanatory variables

[16]This result may seem surprising to some. It is interesting to note that the population coefficient is reasonably precise. That is, it is significantly different from a wide range of positive values. This result is plausible if one does not believe that markets are saturated with recruiters. That is, recruiters are already unable, due to time constraints, to contact all potential enlistments. So, an increase in the population does not necessarily increase the number of individuals contacted. This interpretation makes sense given the rather high recruiter elasticities reported below. Of course, measurement error in the population variable could account for this result.

percentage increase in high quality enlistments holding the number of low quality enlistments constant. The partial elasticities of high quality enlistments with respect to civilian wages, unemployment, and recruiters are estimated to be -1.014, .764, and 1.193 respectively.

In addition, the trade-off parameter, λ, was estimated to be -.393 with a standard error of .099. Evaluated at the mean values for high and low quality graduates, this elasticity estimate yields a tradeoff of slightly greater than four to one. In other words, a recruiting area, by reallocating effort, could attract an additional high quality enlistment for each four lower quality individuals given up.[17]

The model was also estimated using 1981 data. For the most part, coefficient estimates for these regressions were similar. In general, however, the elasticities were smaller in magnitude. The elasticities of high quality enlistments with respect to civilian earnings, unemployment, and recruiters were estimated to be -.164, .307, and .466, respectively. However, the coefficient on civilian earnings was not significantly different from zero. The elasticity with respect to the high quality quota was similar to the 1980 coefficient, .459. On the other hand, the estimated elasticity of high quality recruits with respect to low quality quotas was not significantly different from zero.

[17]Although the estimations presented focus on the tradeoff between high and low AFQT categories of high school seniors and graduates, such tradeoffs occur between all such categories of enlistments, including nongraduates, reserves, women, and prior service individuals. The analysis and estimation methodology is perfectly applicable to these more finely defined output categories. For example, the tradeoff between high quality graduates and all other male enlistments, including nongraduates and low AFQT category graduates was estimated to be between five and seven to one. Unfortunately, the quota variables, proxied by accession quotas led three months, were not as reliable for other categories. For example, the size of potential estimation biases due to measurement error was determined, via reverse regressions (Leamer, 1978) to be significantly larger. Thus, these results are not reported here.

The estimated trade-off elasticity for 1981 was -.274 with a standard error of .114. When evaluated at the 1981 mean values for high and low quality enlistments, a four to one tradeoff is obtained. This tradeoff, identical to that derived using 1980 data, again suggests that high quality enlistments are four times as difficult to recruit as are individuals in the low quality category.

D. RECRUITER INCENTIVES AND ENLISTMENT SUPPLY

Of course, the previous analysis assumes that recruiters will always have incentives to maintain constant levels of effort and fully utilize available resources. However, although recruiter success and subsequent promotion depends on production relative to quota allocations, the rewards for overproduction may not, for a variety of reasons, be sufficient to induce maximum effort at all times. Recruiters may prefer to allocate their time toward leisure activities. Indeed, preliminary evidence suggests that there may even exist disincentives to overproduce. Descriptive regressions of changes in quotas from 1980 to 1981 as a function of various measures of production relative to quotas in 1980 suggest a very strong positive correlation. Recruiters who exceeded quotas in 1980 had relatively higher quotas in 1981. If production in one period redefines standards in the next, extreme success may guarantee failure in the future.[18] Thus, despite the outward shift in the locus of recruiting production possibilities, the recruiter may choose a point which is internal to the frontier.

[18]For example, the elasticity of the percentage change in high quality quotas with respect to the ratio of high quality enlistments to quotas in 1980 was estimated to be .474 with a standard error of .048. So, an area which overproduced by 20-percent in 1980 could expect a 10-percent increase in quotas the next year!

Table 2

THE SUPPLY OF HIGH QUALITY GRADUATES, 1980

	1		2		3	
Variable	Coefficient Estimate	Standard Error	Coefficient Estimate	Standard Error	Coefficient Estimate	Standard Error
Intercept	.156	1.154	-.259	1.062	-.496	1.256
log(W)	-.348	.223	-.803	.260	-1.014*	.294
log(U)	.544*	.146	.575*	.135	.764*	.167
log(R)	.961*	.130	.842*	.153	1.193*	.152
log(P)	-.087	.132	.070	.127	.091	.150
Feb	-.048	.105	-.045	.097	-.052	.114
Mar	-.005	.106	.004	.098	-.003	.115
Apr	-.105	.106	-.098	.099	-.167	.115
May	-.159	.106	-.145	.099	-.263*	.117
Jun	-.200	.106	-.188	.099	-.203	.114
Jul	.039	.107	.365*	.109	-.117	.117
Aug	.056	.106	.384*	.108	.149	.117
Sep	-.137	.106	.200	.109	-.089	.115
log(Qh)			.420*	.094		
log(Ql)			-.421*	.074		
log(L)					-.393*	.099

*Significant at the 5% level.

Table 3

THE SUPPLY OF HIGH QUALITY GRADUATES, 1981

	1		2		3	
Variable	Coefficient Estimate	Standard Error	Coefficient Estimate	Standard Error	Coefficient Estimate	Standard Error
Intercept	-.442	.335	-.042	.086	-.512	1.018
log(W)	-.293	.197	-.164	.216	-.700*	.273
log(U)	.265	.140	.307*	.131	.506*	.182
log(R)	.834*	.102	.466*	.127	1.086*	.153
log(P)	.062	.107	.009	.100	.098	.118
Feb	-.049	.094	-.049	.087	-.056	.103
Mar	-.010	.095	-.008	.087	-.032	.104
Apr	-.124	.097	-.278*	.093	-.154	.107
May	-.276*	.098	-.430*	.093	-.310*	.107
Jun	-.023	.095	-.182	.092	.021	.105
Jul	.204	.096	-.022	.093	.290*	.110
Aug	.087	.097	-.138	.094	.167	.110
Sep	.025	.097	-.202*	.095	.026	.106
log(Qh)			.459*	.066		
log(Ql)			-.051	.066		
log(L)					-.274*	.114

*Significant at the 5% level.

Without appropriate incentives, the observed level of enlistments will understate the potential impact of the exogenous shift in market conditions.[19]

To test these propositions, the sample of 33 recruiting areas was divided into two groups for separate analysis. First, the ratio of high quality enlistments to quotas was computed and averaged for each recruiting area for the two-year period. The mean ratio was .92. That is, recruiters located in a representative MEPS area managed to enlist, on average, a number of high quality individuals equal to about 92 percent of their quotas. Half of the sample had average production of over 92 percent and were placed in the "high achiever" group. The other half, with average production over the two-year period of under 92 percent of high quality quotas, became the "low achiever" group.

Table 4 presents the results of estimating the structural supply expression (6) for the two groups using the 1980 data set. The differences for the two groups are striking. For the high achiever group, only the estimated elasticity for population is significantly different from zero and, even so, the negative sign is not plausible. All the other coefficients are insignificant with large standard errors. Elasticities with respect to earnings and unemployment have incorrect signs. The elasticity with respect to recruiters was estimated to be

[19]This could very well account for the smaller estimated supply elasticities estimated for 1981. On average, recruiters produced only 80 percent of the high quality quota in 1980. In contrast, average production of high quality graduates amounted to 115 percent of the goal for this category in 1981. This change was due to improving recruiting conditions as well as a decline in the overall quota for high quality enlistments. If incentives to exceed quotas are less important from those to achieve them, one would expect a dampened response on the part of recruiters during "good times."

.475, less than half of the whole sample estimate of 1.193, and not significant at the 5-percent level. The estimate of the trade-off parameter, λ, was 1.106 though insignificantly different from zero. Taken at face value, this means that recruiters can increase high quality enlistments at the same time that low quality categories are increased. It is clear that, in comparison with the results for the whole sample, the estimates of the supply parameters using the overproducer group are quite implausible.[28]

The results for low achievers, found in the third set of coefficient estimates, are dramatically different. Indeed, the estimates conform nicely to a priori expectations. The estimated coefficients for demographic variables are significant and appropriately signed. Of particular interest is the rather large wage elasticity of -2.391. In addition, the recruiter elasticity is estimated to be much larger than in the sample as a whole. A 10-percent increase in the number of recruiters would result in a greater than 15-percent rise in high quality enlistments, holding the number of low quality recruits constant. Finally, the trade-off parameter was estimated to be -.302, confirming that lower quality enlistments requirs significant expenditures of scarce recruiting rescurces.

The comparisons of estimates using 1981 data as reported in Table 5 are quite similar. Once again, the elasticity estimates for high achieving areas are strikingly different from those derived from the complete sample of observations. The elasticities with respect to earnings, population, and unemployment do not confirm theoretical expectations. The elasticity of high quality enlistments with respect

[28]For this group, the estimates probably trace choices of points inside the recruiting trade-off curve.

to recruiters is positive and significant, but much lower at .624 than the estimate for the whole sample. Once again, the trade-off parameter, λ, is estimated to be positive, a counterintuitive result. It is apparent that the estimations do not accurately reflect the supply relationships of interest.

Estimates for the low achiever areas again conform to theoretical expectations. The elasticity of high quality enlistments with respect to the civilian wage opportunities is -2.178 with a standard error of .433. For unemployment, the elasticity is .552. Once again, these coefficients suggest that, in areas where recruiters are not typically achieving quotas, the number of high quality enlistments is more elastic with respect to economic changes than in areas characterized by overproduction. For recruiters, the estimated elasticity is virtually the same as that from the 1980 data. The estimated trade-off parameter again indicates that a ten percent decline in low quality enlistments yields about a three percent increase in high quality individuals.

The rather stark and consistent divergence in the estimated supply parameters is quite convincing. Supply elasticities are generally not significant and often have implausible signs for areas where quotas are consistently achieved. In addition, increased resource expenditures on additional recruiters have only limited effects on the number of high quality enlistments. There is a strong implication that recruiters in such areas have few incentives to increase production due to an improved climate once quotas have already been achieved. To some extent, enlistments might increase, but it seems clear that recruiters will not be motivated to maximize the market's potential and take full advantage of economic or resource changes.

Table 4

THE SUPPLY OF HIGH QUALITY GRADUATES
HIGH VS LOW ACHIEVER COMPARISONS, 1980

	Whole Sample		High Achievers		Low Achievers	
Variable	Coefficient Estimate	Standard Error	Coefficient Estimate	Standard Error	Coefficient Estimate	Standard Error
Intercept	-.496	1.256	5.851	5.787	-3.123	1.600
log(W)	-1.014*	.294	1.479	.869	-2.891*	.490
log(U)	.764*	.167	-.078	.443	.592*	.229
log(R)	1.193*	.152	.475	.257	1.568*	.194
log(P)	.091	.150	-.370*	.087	-.051	.169
Feb	-.052	.114	-.003	.162	-.019	.134
Mar	-.003	.115	.072	.167	.024	.135
Apr	-.167	.115	.158	.240	-.112	.135
May	-.263*	.117	.221	.349	-.112	.135
Jun	-.203	.114	-.169	.157	-.162	.134
Jul	-.117	.117	.170	.221	.172	.137
Aug	.149	.117	-.018	.187	.162	.138
Sep	-.089	.115	-.171	.159	-.010	.137
log(L)	-.393*	.099	1.106	.762	-.302*	.088

*Significant at the 5% level.

TABLE 5

THE SUPPLY OF HIGH QUALITY GRADUATES
HIGH VS LOW ACHIEVER COMPARISONS, 1981

	Whole Sample		High Achievers		Low Achievers	
Variable	Coefficient Estimate	Standard Error	Coefficient Estimate	Standard Error	Coefficient Estimate	Standard Error
Intercept	-.512	1.018	2.996	1.668	1.783	1.454
log(W)	-.700*	.273	.707*	.284	-2.178*	.433
log(U)	.506*	.182	-.411	.283	.552*	.229
log(R)	1.086*	.153	.624*	.165	1.553*	.234
log(P)	.098	.118	-.273*	.049	-.019	.152
Feb	-.056	.103	-.079	.109	-.046	.121
Mar	-.032	.104	.052	.111	-.083	.122
Apr	-.154	.107	-.110	.114	-.183	.125
May	-.310*	.107	-.432*	.115	-.210	.125
Jun	.021	.105	-.140	.119	.038	.122
Jul	.290*	.110	-.015	.130	.361*	.128
Aug	.167	.110	-.108	.132	.224	.128
Sep	.026	.106	-.144	.115	.204	.124
log(L)	-.274*	.114	.452*	.193	-.290*	.117

*Significant at the 5% level.

Unfortunately, it appears that observed enlistments in such circumstances do not represent the production frontier, but instead are internal points. To the extent that some recruiters and recruiter managers may be more motivated than others to exceed quotas, one might expect a positive relationship between numbers of high and low quality enlistments for these areas. That is, once quotas are achieved, some areas will exhibit no increases in enlistments of any type, despite economic or resource effects which would shift the supply or trade-off curve outward. Other areas might be so motivated and one would observe a point closer to the frontier of the supply possibility curve. That is, such areas could exhibit higher numbers of both high and low quality enlistments. Thus, for this subset of recruiting areas, there exists a correlation between high and low quality which is not representative of any supply relationship but, rather, reflects systematic differences in recruiter behavior.

On the other hand, the results for low achievers are quite satisfactory. Certainly, the coefficients are "well-behaved." That is, they conform to theoretical expectations as well as previous estimations. Most convincingly, they are quite similar for the two years. Coefficient estimates are quite precise and do not differ significantly for the different periods. In general, the results suggest that, if recruiter incentives are taken into account, estimated enlistment responses to changes in economic factors and resource expenditures will be greater.

E. STRUCTURAL DEMAND AND SUPPLY ESTIMATES

As indicated, the above results were obtained by jointly estimating an approximation to a reduced-form expression for low quality graduates along with the structural supply relationship (6). However, it is possible, though costly, to utilize expression (10) which can be directly derived from an explicit expression for recruiting objectives (9). This exercise was undertaken for two important reasons. First, it provides an indication of how sensitive the supply elasticity results are to the specification of demand relationships. Second, the estimates of demand parameters can provide more direct information on the nature and significance of recruiting objectives in the determination of enlistment supply. Table 6 presents the results of a nonlinear two-stage estimation procedure as applied to both structural expressions (6) and (10) for the low achiever groups for both 1980 and 1981.[21]

The estimated supply parameters were virtually identical to those obtained using the simpler estimating methodology. The elasticities with respect to unemployment, civilian wages, and recruiters all fall within a standard deviation of those derived using the more simple methodology. In addition, the trade-off parameter estimates, -.367 and -.274 for 1980 and 1981, respectively, are remarkably close to the -.302 and -.290 reported earlier. This assures us that the results for the supply relationships are not sensitive to the functional representation of demand factors.

[21]See Berndt, Hall, Hall, and Hausman (1974) for a description of the computational procedure.

The model was estimated under the assumption that recruiters must, at a minimum, achieve the total volume mission. That is, the ratio of total enlistments to t' . total quota must be at least one.[22] With the subsistence parameter, γ_t, constrained to be equal to one, expression (9) which specifies recruiting objectives or demand becomes:

$$(11) \qquad U = \theta \log[(H/Q_h) - \gamma_h] + (1 - \theta)\log[(T/Q_t) - 1]$$

Again, T is the total number of enlistments and the Q's are enlistment quotas. The high quality subsistence parameter, γ_h, was estimated to be .973 for 1980, with a standard deviation of .043. For 1981, the estimate was .929 with a standard error of .034. This suggests that recruiters take their quotas for high quality enlistments quite seriously. That is, the data indicate that the minimum acceptable number of high quality enlistments is very close to the production quota or goal. The estimates of the parameter θ, .755 and .825, are not significantly different for 1980 and 1981. This parameter indicates the relative weight placed on production of high versus low quality enlistments in recruiting objectives.[23] The relative importance of high

[22]This restriction facilitated the convergence of the estimates to the maximum likelihood solution. Likelihood ratio tests comparing the sum of residuals for the restricted versus unrestricted reduced-form expressions for high quality graduates permitted rejection of the hypothesis that the restriction decreased explanatory power. This fact, along with the testimony of several recruiters who claimed that they did, indeed, behave in this manner, seemed to justify the parameter restriction on the grounds of computational convenience.

[23]Strictly speaking, the marginal rate of substitution of high for low quality enlistments in recruiting objectives also depends upon the value of the shift or subsistence parameters, γ_h and γ_t. That is, the weight parameter, θ, indicates the relative importance of "supernumerary" enlistment production. If the values of the γ's are in the neighborhood of (1,1), the estimate of θ can be interpreted as signifying the relative importance placed on high and low quality graduates.

quality enlistments, given by the ratio $\theta/(1 - \theta)$, is therefore computed to be 3.08 in 1980. On the margin, high quality enlistments are more highly valued by recruiters.

Table 6

STRUCTURAL MODEL ESTIMATES:
RECRUITER OBJECTIVES AND ENLISTMENT SUPPLY

	1980		1981	
	Coefficient Estimate	Standard Error	Coefficient Estimate	Standard Error
Supply Parameters				
log(U)	.658	.250	.535	.267
log(W)	-3.100	.569	-2.142	.516
log(R)	1.647	.218	1.529	.304
log(L)	-.367	.120	-.274	.167
Demand Parameters				
θ	.755	.080	.825	.107
γ_h	.973	.043	.929	.034

III. CONCLUSIONS

This paper suggested and applied a modeling approach that explicitly considers the role of recruiter behavior in the determination of enlistments. This analysis demonstrated that the traditional focus solely on the supply of single categories of enlistments is deficient. This is because recruiters, by allocating their time in response to goals--and the incentives to meet and exceed these goals--can alter both the quantity and quality of enlistments. Ignoring recruiter behavior and the demand factors affecting their choices can yield incorrect estimates of the effects of economic changes and resource expenditures.

In general, estimated elasticities of high quality enlistments with respect to supply variables such as the unemployment rate and civilian wages are significantly higher if recruiter choices are taken into account. Of particular importance is the finding that, although Army recruiters appear to be motivated to attain quotas for both high and low quality enlistments, there exist few incentives to exceed them. This strongly suggests that recent efforts utilizing traditional supply models to forecast enlistments or assess the impact of a variety of educational benefits, enlistment bonuses, and advertising expenditures are of limited value.[24]

To this point, the modeling of recruiter behavior, though illustrative and of demonstrated empirical importance, has been overly simplistic. A more sophisticated model of demand may, in all

[24]During fiscal years 1982 and 1983, recruiters had little difficulty achieving quotas for both high and low quality categories. This would have severely dampened the observed supply effects of resource expenditures, enlistment bonuses, or advertising campaigns.

probability, indicate that that quotas can affect recruiters in a less predictable manner. Indeed, the relationships between quotas, potential supply, relative rewards, and recruiting effort is likely to be quite complex.[25] These complexities can have profound implications for the efficient management of recruiting resources as well as for the appropriate estimating model to account for such demand factors. Future work must explicitly imbed such factors as the allocation of effort and the role of recruiter rewards, assess their importance, and provide empirical estimates which will document the interaction between these factors, supply conditions, and resource expenditures.

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[25]For example, it may be that the recent downturn in Army recruiting is not solely due to improved economic conditions which have increased civilian opportunities. Rather, it may be the result of high quality quotas being set unrealistically high. Suddenly unable to achieve quotas which were established during a period of productive recruiting, recruiters may, on the margin, have fewer incentives to secure enlistments. Thus, the observed enlistment declines due to the economic recovery may have been aggravated by an inflexible quota allocation.

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